6.1 Understanding Interest – Overview

Definitions / Key Ideas

Interest – Amount charged for borrowing money or earned from investing

Principal – Initial investment or loan amount.

Annual Percentage Rate (APR) – Yearly interest rate (normally given as percentage per year).

Simple Interest – Only calculated on the principal.

Compound Interest – Calculated on principal and accrued interest.

Continuously Compounded Interest – Interest is compounded continuously.

Annual Percentage Yield (APY) – Effective annual interest rate (accounts for compounding).

(*n* values)

Table 1: Compounding Intervals

Compounding	Number per Year
Annually	1
Semiannually	2
Quarterly	4
Monthly	12
Weekly	52
Daily	365

Formulas and Examples

How much money will I have if… And how much interest will I earn if…

1. Simple Interest

$I = Prt$ (I: Interest, P: principal, r: rate (decimal), t: time)

Ex: I invest $500 at 10% APR with simple interest for 8 years? For 6 months?

$I = 500(0.10)8$
$= \$400$

$A = P + I$
$= 500 + 400 = \$900$

$I = 500(0.10)\frac{6}{12}$
$= \$25$

$A = P + I$
$= 500 + 25 = \$525$

2. Compound Interest (regular)

$A = P\left(1 + \frac{r}{n}\right)^{-nt}$ (n: # of compounding periods; A: Future (total) value)

Ex: I invest $500 at 10% APR for 8 years, compounded monthly? Quarterly?

$A = 500\left(1 + \frac{0.10}{12}\right)^{12(8)}$
$= \$1109.09$

$I = A - P$
$= 1109.09 - 500 = \$609.09$

$A = 500\left(1 + \frac{0.10}{4}\right)^{4(8)}$
$= \$1101.88$

$I = A - P$
$= 1101.88 - 500 = \$601.88$

3. Compound Interest (continuous)

$A = Pe^{rt}$

Ex: I invest $500 at 10% APR for 8 years with continuous compounding?

$A = 500\,e^{0.10(8)}$
$\approx \$1112.77$

$I = A - P$
$= 1112.77 - 500 = \$612.77$

4. Annual Percentage Yield

$APY = \left[\left(1 + \frac{r}{n}\right)^{n} - 1\right] * 100$

Ex: What is the Annual Percentage Yield (APY) for example 2?

$APY_{monthly} = \left[\left(1 + \frac{0.10}{12}\right)^{12} - 1\right] * 100$
$= 10.47\ \%$

★ calculator tip → Type all in one step ★

Examples

Example 1: Suppose you wish to borrow $200 for five weeks and the amount of interest you must pay is $20 per $100 borrowed. What is the APR at which you are borrowing money?

Simple Interest

$I = Prt$ ⟶ $\frac{40}{200} = \frac{200r}{200}\left(\frac{5}{52}\right)$

$I = \$20/\$100 \Rightarrow \$40$ for $\$200$ borrowed

$\frac{52}{5} \cdot \frac{1}{5} = r \cdot \frac{52}{52} \times \frac{52}{5}$

$P = \$200$

$r = 2.08 \xrightarrow[\text{Convert to \%}]{*100}$ $r = 208\%$

$r = ??$

$t = \frac{5 \text{ weeks}}{52 \text{ weeks}} = 5/52$

Example 2: Suppose that $13,000 is deposited for eight years at 4% APR. Calculate the interest earned if interest is compounded weekly. Round your answer to the nearest cent.

☆ Compound Interest

$A = P\left(1 + \frac{r}{n}\right)^{nt}$ ⟶ $A = 13{,}000\left(1 + \frac{0.04}{52}\right)^{52(8)}$

$\downarrow \approx \$17{,}900.46$

$A = \$13{,}000$

$r = 4\% = 0.04$

$n = 52$ (weeks)

$t = 8$ (years)

$I = A - P$

$= 17{,}900.46 - 13{,}000$

$= \$4{,}900.46$